SECTION 5

5.12 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA):

Supervisory Control and Data Acquisition (SCADA) installed for use by Denver Water monitor, control and coordinate the operations of its water system, or the operations between a Distributor's water system and Denver Water's system, shall be designed, installed, and maintained according to the following standards and practices:

A. General:

1. All equipment and instruments comprising the SCADA shall be in accordance with MS-29 subject to approval by Denver Water. This equipment shall be used unless otherwise indicated by Denver Water.

2. Construction and installation of these systems shall be in accordance with design drawings and specifications submitted to and approved by Denver Water prior to commencement of construction of the system. Designs and specifications shall be prepared using ISA industry standard electrical/electronic and instrumentation symbols and drafting practices. Any changes in design or equipment specifications on approved plans will require reapproval by Denver Water before the changes are implemented in the system. Only drawings approved by Denver Water's Process Control Section shall be used for construction and installation of the SCADA system.

   a. For systems requiring 15 I/O points or less (in any combination of analog and digital points) and containing no more than one closed loop control loop, the following documentation is required by Denver Water.

      Control viewpoint containing an overview of how the system is to operate including: a listing of digital and analog I/O points, control loop descriptions, set points, normal operating ranges, alarm points operating sequence and operator interface information.

      This document shall be submitted to Denver Water's Process Control Section before commencement of construction. The control viewpoint is used for check-out, start-up, system revisions and maintenance.

      Equipment list detailing the following for all equipment and instruments: equipment tags to be used throughout drawings (ISA standards preferred), manufacturer and model number, and a concise description of the manufacturer's specifications as they apply to the requirements of the process. Manufacturer's cut-sheets and literature shall accompany this list. The equipment list is used by Denver Water's Process Control Section to review

equipment submitted for approval, and as a cross-reference guide for the drawing package.

Instrumentation and Control P and ID Typical showing the instruments and associated equipment interconnections in block form using ISA standards. The nomenclature established on the equipment list should be used here. The flow of signals shall move from left to right across the drawings. Normal operating points, signal levels, frequencies, and instrument adjustments shall be shown. P&ID's are intended to be used for design and installation. See Sheet 64 of the Standard Drawings.

Instrumentation and Control Cabinet Layout Typical including layouts for all operating stations, push-button stations, terminal boxes, control equipment enclosures, etc., to clearly show the location of all panel-mounted telemetry/control system components. Panel layout drawings are intended to be used for fabrication, installation and maintenance. See Sheet 62 of the Standard Drawings.

Instrumentation and Control Detail and Schedules Typical including a parts/instrument material schedule for all equipment located in enclosure, name plate schedule, panel cut-out details, etc. These drawings are also intended for use in fabrication, installation and maintenance. See Sheet 63 of the Standard Drawings.

Instrumentation and Control Ladder Diagram Typical showing all necessary electrical connections to equipment in schematic form and ladder logic, if applicable. Any set points or other information pertinent to the installation of the system shall be included. All information regarding power requirements shall be shown, including: main power feed capacity, voltage and origin; and transformer and power supply available load and operating voltage

Wiring details such as wire numbers, colors and sizes, along with terminal numbers/ names for all terminals whether off a terminal strip or instrument terminal, is required. Concise nomenclature for all equipment functions is required. Schematics are intended for use in fabrication, installation and maintenance. See Sheet 60 of the Standard Drawings.

Software documentation in the form of a hard copy printout and a 3-1/2 inch diskette copy of the completed program is required, if applicable.

b. For systems requiring more than 15 I/O points or containing more than one closed loop control loop, the following drawings are required along with those outlined above:

Instrumentation and Control Site Diagram Typical showing the relative locations of all panels and field mounted instruments in plan view and using the designated nomenclature from the equipment list. Component layouts are intended to aid in installation and maintenance. See Sheet 65 of the Standard Drawings.

Instrumentation and Control Wiring Diagram Typical showing the actual wiring interconnections from terminal in graphical form. This drawing is used for installation and check-out and is not expected to be maintained after start-up. See Sheet 61 of the Standard Drawings.

3. Equipment and wiring shall be installed and mounted in such a manner as to provide easy access and protection from mechanical and thermal damage as well as condensation or other forms of moisture. NEMA standards shall be applied for all enclosures. All wiring connections shall be done in a neat workmanlike manner, and shall be laced or bundled using cable ties, or enclosed in PVC wiring duct. In-line splices or wire nuts shall be allowed. Each end of a wire shall be identified by a permanent wire marker that corresponds to the wire identification used on the final as-built detailed drawings. No more than 2 wires shall be permitted on each terminal block screw. A minimum of 10 percent of the terminal block positions or din rail space shall be provided as spare for future changes or additions. Twisted, shielded pairs shall be used for all instrumentation wiring for analog devices (4-20mA signals, etc.). Terminations of analog signal wires shall be made by Denver Water's Process Control Section unless otherwise specified. All low voltage DC wires shall have separate conduit runs from 120VAC and higher voltage wires. Each separate instrument or device in the system shall have affixed to it a permanent identification label corresponding to the final as-built detailed drawings. The latest editions of NEC and OSHA's "Design Safety Standards for Electrical Systems" shall set the minimum standards of which all design, equipment, and installation must conform. Denver Water may designate additional standards to insure safety, reliability and compatibility with existing systems. Wire coloring code shall adhere to the following:

120VAC power - Black
120VAC neutral - White
GROUND - Green
12, 24, 48VDC power - Red
12, 24, 48VDC common - Black w/red stripe
Digital outputs (control) open, start - Red
close, stop - Blue

Digital inputs (status, alarms) - Yellow
Telephone wiring (communication) - Orange

4. A site inspection by Denver Water's Process Control Section is required prior to installation of telemetry/control equipment. Contractor shall notify Denver Water's Process Control Section at least one week in advance of commencement of the installation to arrange an inspection date. SCADA system operation shall agree with the control viewpoint previously approved. All SCADA systems and equipment shall be subject to inspection and operational acceptance tests by Denver Water's Process Control Section before being placed into service. All wires shall be inspected for continuity and termination, and all instruments shall be tested to ensure proper operation. Contractor shall notify Denver Water's Process Control Section one week in advance of the completion of installation to arrange a final inspection date.

5. Pressure transmitters shall be installed in the center of the conduit and "teed" with a pressure sign gauge for local pressure readings. All flow measurements shall be a combination of 2 differential pressure transmitters; a high range transmitter calibrated for the maximum design flow rate and a low range transmitter calibrated to 25% of the maximum design flow rate. Level transmitters (including pressure transmitters used for level measurement) shall be installed on a separate sensing line. No other instrumentation shall be permitted on this sensing line.

6. Control systems, which incorporate sources of motive power, shall utilize either electrical or hydraulic (oil) fluid power actuator mechanisms. Use of compressed air as a prime motive power source or compressed air powered actuators are not allowed. Use of air over oil accumulators as a source of reserve hydraulic power is allowed. These motive power systems shall be included in the SCADA system drawings submitted for approval. Standard Electrical Industry and National Fluid Power Association drafting symbols and practices shall be used.

7. Three copies of all manufacturer's instruction manuals, parts lists, and service information, as well as 3 sets of the as-built drawings, control viewpoint and equipment lists shall be provided to Denver Water within 30 days after the completion of start-up and satisfactory performance of the equipment has been achieved, as dictated by Denver Water.

B. Additional Requirements for Coordinating Operations Between a Distributor's Facility and Denver Water.

1. The required standard for these SCADA systems shall be no higher than those used for telemetry installations made by Denver Water and shall adhere to the specifications outlined in the above 5.12 A. The control viewpoint shall be used as the design standard and written in conjunction with the Distributor and Denver Water's Process Control Section.

2. SCADA system power shall be provided by the Distributor including all conduit and wires from power source to telemetry and control panel and/or field devices. All other labor related to the design, construction and maintenance shall be provided by Denver Water and paid for by the Distributor, unless otherwise requested by the Distributor and approved by Denver Water.

3. The minimum I/O points required for treated water distribution are:

   Up-stream pressure (analog signal)
   Down-stream pressure (analog signal)
   Valve position (analog signal)
   Remote/local control selector switch position (digital signal)
   Local open/close valve selector switch (hardwired digital signal)
   Valve open command (digital signal)
   Valve close command (digital signal)
   Water on Floor (WOF) alarm (digital signal)
   Vault intrusion alarm (digital signal) - optional

4. All instruments and equipment shall be of a manufacturer and model specified by MS-29, unless otherwise approved by Denver Water's Process Control Section. Any telemetry and control equipment not specified in MS-29 must be approved by Denver Water's Process Control Section before purchase by the Distributor.

5. Denver Water shall specify, order and pay for the monthly service of any telephone lines required for the system. The Distributor shall pay for the initial connection fee.

6. Within 30 days after completion of the system, the Distributor shall provide Denver Water with all keys necessary to gain 24 hour access to the telemetry system located at the Distributor's facility.

7. Any additions, changes, or other modifications to the SCADA system after it has been placed into service must be approved by Denver Water prior to implementation. The required work shall be done by Denver Water unless otherwise requested by the Distributor and approved by Denver Water's Process Control Section. Distributor shall provide as-built drawings and documentation within 30 days after completion of the approved work to Denver Water's Process Control Section.